

RTCA Special Committee 186, Working Group 3

ADS-B 1090 MOPS, Revision A

Meeting #12

**Draft of MOPS Material for TIS-B Message Processing and Reporting,
Sections 2.2.17.4 to the end of 2.2.17**

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SUMMARY

The second draft of TIS-B reporting material was reviewed at the previous meeting. In the discussion, several changes were suggested. These have been incorporated in the draft. This paper presents the revised draft of this TIS-B material.

This paper addresses action item # 11-05.

All text changed from the previous Working Paper (1090-WP-11-12) are presented in RED.

**Draft of MOPS Material for TIS-B Message Processing and Reporting,
Sections 2.2.17.4 to the end of 2.2.17**

Beginning in our January 2002 meeting, our Working Group decided on an approach for TIS-B. The received TIS-B information will be reported directly, with a minimum of processing. One element for which processing is required is latitude-longitude decoding, which requires global decoding by combining even and odd receptions.

This paper presents the third draft of the requirements for TIS-B reporting, based on comments and decisions at the meeting in May. The following specific changes were made.

- (1) Addition of a test for invalid addresses, specifically all zeros and all ones.
- (2) Addition of a note saying that a track reasonableness test may be applied.
- (3) Addition of a requirement to generate a full state vector report when either a position or a velocity message is received.
- (4) Simplification of the track-state figure as discussed at the meeting.

A few wording changes were also made to improve clarity, and section reference numbers were corrected in several places.

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2.2.17.4 TIS-B Message Processing and Report Generation

The information received in TIS-B messages is reported directly to applications, with one exception. The exception is latitude-longitude position information, which is CPR-encoded when it is received, and must be decoded before reporting. In order to accomplish CPR decoding, it is necessary to track received messages, so that even-format and odd-format messages can be combined to determine the latitude and longitude of the target.

In the most common case, a particular target will result in TIS-B message receptions or ADS-B message receptions, but not both. It is possible, however, for both types of messages to be received for a single target. Therefore TIS-B messages are compared with tracks of previous TIS-B receptions and tracks of ADS-B receptions. The tracking structure within ADS-B can either use separate tracking of TIS-B receptions and ADS-B receptions or combined tracking of the two types of receptions.

2.2.17.4.1 TIS-B Message-to-Track Correlation

Tracking makes it possible to associate a received message with information previously received about that same target, in the presence of many other intervening messages about other targets. As TIS-B position messages are received, they are compared with existing tracks. If a received TIS-B message correlates with an existing track, the message is decoded (2.2.17.4.2), the track is updated (2.2.17.4.3), and a report is generated (2.2.17.6). If the new message does not correlate, it is used in new-track initiation (2.2.17.4.4).

2.2.17.4.1.1 TIS-B Messages Having a 24-Bit Address

For a target that has a 24-bit address, that address is used for correlating new receptions with information in the track file. Correlation is successful if the address matches exactly. **If the 24-bit address in a received message is either all zeros or all ones, it is considered to be illegal, and the message shall be discarded.** Otherwise, when a TIS-B position message having a 24-bit address is received, and an existing TIS-B track has the same address, the message shall be correlated with the track. When a TIS-B message having a 24-bit address is received, and an existing ADS-B track has the same address, the message shall be correlated with the track.

2.2.17.4.1.2 TIS-B Messages Having Mode A Code and Track Number

For a target **not identified by** a 24-bit address, but instead **having** a Mode A code and a TIS-B track number, then these are used to correlate with information in the track file. Correlation is successful if the Mode A code and the track number both match exactly. When a TIS-B message having a Mode A code and TIS-B track number is received, and an existing TIS-B track has the same Mode A code and ADS-B track number, the message shall be correlated with the track.

2.2.17.4.2 TIS-B Position Message Decoding

When a received TIS-B position message correlates to an existing track, the message and the track are used together to decode the latitude and longitude of the target. If the track is “Complete”, meaning that a global decode has been accomplished, then the new latitude-longitude information shall be decoded using local decoding, as specified in A.1.7.4 in Appendix A, taking the previous position of the target as the reference.

If the track is Incomplete, meaning that a global decode has not yet been accomplished prior to this reception, then a global decode may be computed depending on the contents of the track. If the information in the track together with the new position message consist of at least one even format message and at least one odd format message received within 10 seconds, then a global decode shall be computed as specified in A.1.7.7 of Appendix A. Otherwise the received encoded position, the even/odd format, and the time of applicability, shall be saved in the track file for later use.

For ADS-B tracks, as illustrated in Figure 2-16b, a track is Complete if it is in the Track State or is in the Acquisition State. Otherwise the track is Incomplete.

Note. When decoding positions, a reasonableness test may be applied.

2.2.17.4.3 TIS-B Track Update

When a position message is correlated to a TIS-B track that is Complete, then a new position is computed as specified in 2.2.17.4.2 and the tracked position shall be updated with the new position and time of applicability. The previous position and time need not be saved. Figure 2.2.17.4.3 illustrates the transition from Incomplete track to Complete track and later track drop.

When a position message is correlated with a TIS-B track that is Incomplete, the new information may make it possible for a global decode, as specified in 2.2.17.4.2. If a global decode is accomplished, the track shall be promoted to Complete, and the latitude, longitude, and time of applicability shall be saved in the track. The previous position and time information need not be saved. If a global decode is not accomplished, the even and odd encoded positions shall be saved for future decodes.

Note. It is not necessary to save any encoded positions longer than 10 seconds.

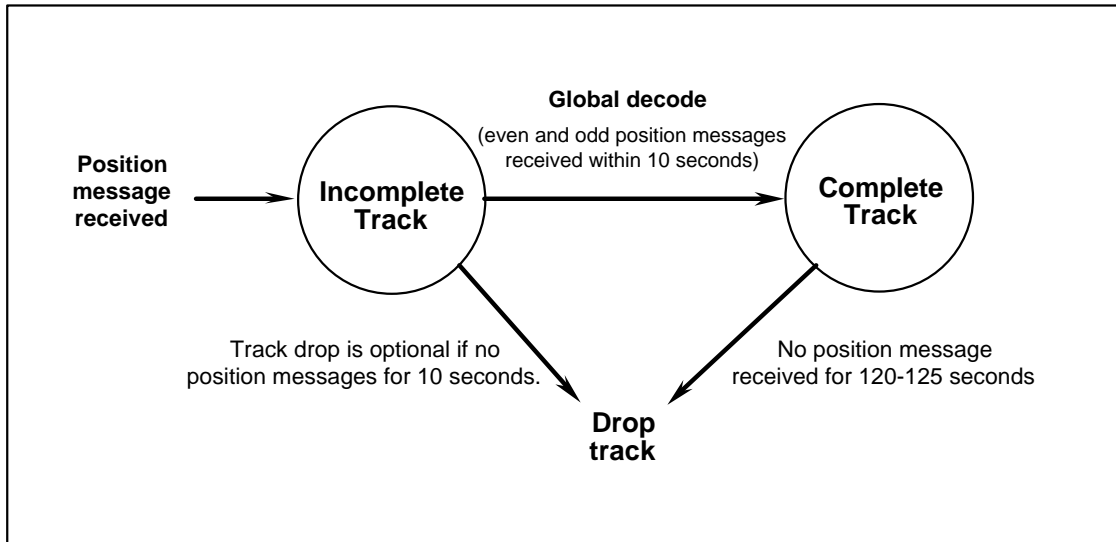


Figure 2.2.17.4.3. TIS-B Tracks

2.2.17.4.4 TIS-B Track Initiation

A TIS-B track begins with the reception of one position message. A new Incomplete track shall be created, and the encoded position, even/odd format bit, and time of applicability shall be saved.

2.2.17.4.5 TIS-B Track Drop

A TIS-B track that is Complete shall not be dropped within 120 seconds after any TIS-B position message reception. If 125 seconds elapses without any TIS-B message reception, the track shall be dropped.

Note. As specified in 2.2.17.4.3, for an Incomplete TIS-B track, it is not necessary to save any information more than 10 second after reception. Therefore the track can be dropped after 10 seconds.

2.2.17.4.6 TIS-B Report Generation

As TIS-B messages are received, the information is reported to applications. All received information elements, other than position, shall be reported directly. The reporting format is not specified in detail, except that the information content reported shall be the same as the information content received. The report shall be issued within 0.5 seconds of the message reception.

When a TIS-B position message is received, it is compared with tracks to determine whether it can be decoded into target position, as specified in 2.2.17.4.2. If the message is decoded into target position, a **state vector** report shall be generated, within 0.5 seconds of the message reception. The report shall contain the latitude, longitude, altitude, **estimated velocity**, address, time of applicability, and all other information in the received message. **The estimated velocity shall include north-south velocity, east-west velocity, and altitude rate.**

These rates shall be estimated based on the received position information and the track history of this target.

When a TIS-B velocity message is received, if it is correlated to a complete track, then a state vector report shall be generated, within 0.5 seconds of the message reception. The report shall contain the received velocity information, estimated position, address, time of applicability, and all other information in the received message. The estimated position shall include latitude, longitude, and altitude. These values shall be estimated based on the received velocity information and the track history of this target.

Note. In the absence of TIS-B message receptions, it is possible for reports to be generated, but this is not required. Such additional reports might be useful as a means of counteracting possible flaws in an on-board data bus between ADS-B and an application.

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